

# Influencing Factors of Executive Tenure Based on Cox Proportional Risk Regression Model

Ningyuan CHEN <sup>a1</sup>

<sup>a</sup>*Business School, Beijing Wuzi University, Beijing, China*

**Abstract.** This article constructs a Cox proportional hazards regression model based on survival analysis methods to explore the factors influencing executive tenure. By utilizing individual characteristics of executives and governance structure data from the CSMAR database, the potential influencing factors are divided into personal traits of executives and the nature of the companies they serve. Through the significance test of the Cox proportional hazards regression model, 10 factors that significantly affect executive tenure are determined. This research provides some insights for companies to achieve better corporate performance and for executives to improve their career planning.

**Keywords.** executive tenure, Cox proportional hazards, survival analysis, listed companies

## 1. Introduction

Executive tenure, defined as the length of time an executive serves in a specific position within an organization, has long been a topic of interest and importance in the field of management (Buchwald and Hottenrott, 2019)[1]. The understanding of factors that influence executive tenure not only contributes to the knowledge of organizational dynamics but also holds significant implications for corporate performance and individual career planning.

In recent years, existing literature often includes executive tenure as part of the individual characteristics of executives when studying their relationship with other organizational features or their impact. For example, Wu and Zhang (2022) [2] examined the moderating effect of executive individual characteristics on the differentiation of entrepreneurial scramble, specifically market turbulence. Li and Duan (2021) [3] explored the influence of executive identity characteristics on organizational conventions from the perspective of leadership behavior. Lin and Ma (2021) [4] investigated the relationship between executive team demographic background characteristics and corporate innovation intensity using data from listed companies in Guangdong Province. Yang, Luo and Ren (2022) [5] studied the relationship between executive background and earnings management in enterprises. In these studies, executive tenure was often treated as an explana-

---

<sup>1</sup>Corresponding Author, Ningyuan CHEN, School of Business, Beijing Wuzi University, China; Email: chenny6@yeah.net

tory variable to examine its relationship with other dependent variables. Moreover, executive tenure was not considered as the main research factor within the explanatory variables. As for the research results, Atayah al (2021) [6] believes that long-term executives tend to adopt strategies and decisions with less risk. Cao et al (2021) [7] believes that CEO compensation and board supervision can provide a new research approach to help explore the boundary conditions of the relationship between CEO tenure and corporate financial performance. Brown et al (2017) [8], based on the theory of executive cognition and social capital, believed that investors would pay attention to the tenure of directors.

There is limited research that specifically focuses on executive tenure as the dependent variable, which hinders our understanding of the various aspects related to executive tenure. Therefore, this study aims to investigate the influences on executive tenure itself by examining the personal traits of executives and the characteristics of the organizations they serve. By considering executive tenure as the dependent variable, we aim to provide insights into the factors that affect executive tenure and shed light on the complexities surrounding it.

This study aims to explore the influencing factors of executive tenure by employing a Cox proportional hazards regression model. By utilizing data from listed companies and considering both individual characteristics of executives and organizational governance structures, we seek to identify key factors that significantly affect the length of time executives remain in their positions.

The choice to focus on listed companies is motivated by the unique characteristics and dynamics associated with these organizations. The pressures of shareholder expectations, market competition, and regulatory environments create a distinct context in which executive tenure is subject to particular influences and challenges.

Understanding the factors that influence executive tenure in the context of listed companies is crucial for both practitioners and scholars. For organizations, identifying and managing these factors can lead to better corporate performance, increased stability, and enhanced strategic decision-making. For executives, recognizing the determinants of their tenure can inform career planning, guide professional development efforts, and ultimately contribute to long-term success.

In light of the significance of executive tenure and the potential implications for both individuals and organizations, this study aims to provide valuable insights into the influencing factors using a rigorous analytical approach. By employing a Cox proportional hazards regression model, we expect to shed light on the key determinants of executive tenure and contribute to the existing body of knowledge in the field of management and organizational studies.

## **2. Methodology**

### *2.1. Theoretical basis*

Cox proportional risk regression models (Cox regression models) are used in medical statistics to investigate whether a drug or treatment has an inhibitory effect on patient mortality, requiring the dependent variable to be time and requiring the data to be marked for censoring and truncation. It can also be used to analyse the extent to which different factors influence the duration of a phenomenon, without regard to the form of the dis-

tribution of the survival data itself, the completeness of the data, or the absence of data, and can explore the extent to which multiple factors influence the persistence of the phenomenon at the same time. The Cox proportional hazards regression model is a useful tool for analyzing survival data, but it has some limitations that should be considered when interpreting the results (Gill 1982) [9].

The Cox regression model is constructed using the product of the baseline hazard function  $h_0(t)$  and the corresponding covariate function  $f(x)$  to represent the hazard rate function  $h(t)$  (Bai, Liu and Cao, 2021) [10].

$$h(t) = h_0(t) \cdot f(x) \quad (1)$$

$$f(x) = \exp \sum_{i=1}^n \beta_i x_i \quad (2)$$

Where  $x$  is the effect of duration,  $t$  is a given time and  $h(t)$  is the probability that the phenomenon will persist at  $t$ . In cases where the type of distribution of the baseline hazard function is not clear, the parameters of the Cox regression model skip the baseline hazard and do not directly resolve the relationship between the survival function  $S(t)$  and the covariates, using the risk function  $h(t)$  as the dependent variable to determine the extent to which the influencing factor affects the survival function:

$$h(t, X) = h_0(t) \exp(\beta^T X) = h_0(t) \exp(\beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n) \quad (3)$$

where  $h(t, X)$  denotes the risk rate of an individual with influence  $X$  at time  $t$ ,  $h_0(t)$  is the non-parametric part, which is the underlying risk rate when all hazard functions are zero;  $\exp(\beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n)$  is the parametric part;  $\beta = (\beta_1, \beta_2, \cdots, \beta_n)$  is the partial regression coefficient, and  $X = (x_1, x_2, \cdots, x_n)$  when other factors do not change.  $\beta = (\beta_1, \beta_2, \cdots, \beta_n)$  is the partial regression coefficient, and  $X = (x_1, x_2, \cdots, x_n)$  is the potential influence on survival time if other factors do not change.

According to the relationship between the survival function  $S(t, X)$  and the risk function  $h(t, X)$ :

$$S(t, X) = \exp \left[ - \int_0^t h(t, X) dt \right] \quad (4)$$

The relationship between the influence  $X$  and the survival function is obtained, where  $S_0(t)$  is the probability that the phenomenon will last longer than  $t$  if all the influences are zero.

$$S(t, X) = \exp \left[ - \int_0^t h(t, X) dt \right] = \exp \left[ - \int_0^t h_0(t) \exp(\beta^T X) dt \right] = [S_0(t)]^{\exp(\beta^T X)} \quad (5)$$

The influence of the various factors on the duration of congestion depends on the influence coefficient  $\beta$ . Using the partial likelihood function to estimate  $\beta$  and calculating the

baseline risk rate function and risk function, the extent to which factors are associated with the duration of the phenomenon can be clarified. If  $\beta < 0$ , it means that the factor can increase the survival probability of the phenomenon duration, the phenomenon is more likely to last and is a protective factor for the phenomenon duration; if  $\beta = 0$ , it is an irrelevant factor for the phenomenon; if  $\beta > 0$ , it can decrease the survival probability of the phenomenon duration, the phenomenon is less likely to last and is conducive to the phenomenon dissipation.

Since executive tenure is influenced by a variety of individual characteristics and external factors, and the type of distribution is difficult to determine, a Cox proportional risk regression model can be constructed to determine the relationship between executive tenure and the influencing factors. The risk ratio reflects the influence of the influencing factors on the likelihood of an executive's tenure lasting and determines whether the tenure will last. When the coefficient of an influencing factor is less than zero, it indicates that the influencing factor is conducive to executives prolonging their tenure, while the opposite is likely to cause executives to leave.

## 2.2. Data sources

Data on executive tenure and the factors that influence it were obtained from the CS-MAR Executive Personality and Governance Structure database. Data for all corporate executives with a statistical cut-off date of 31 December 2021 was selected for the study and those with an incumbency date later than 31 December 2021 were excluded as they would result in a negative survival time. Data without an "end date of current employment" is truncated to the right. As the "job category" and "specific job title" in the database cannot be fully aligned, for convenience, the top four positions were analysed for executives holding multiple positions and duplicate data was processed for multiple positions, i.e. as two different executives. This resulted in 72,593 data on the length of time held by executives, their personal attributes and the nature of the company. To be clear, there are limitations to using only data from Chinese companies.

## 2.3. Variable description

To accommodate the construction of the Cox proportional risk model, a portion of the original variables from the database were processed and the final selection of variables is shown in Figure 1, and the model will explore the impact of these factors on executive tenure.

## 2.4. Model construction

The following Cox proportional risk model is constructed and the research hypothesis  $i(i = 1, 2, \dots, 16)$  is formulated: the influencing factor  $x_i$  has an impact on the duration of executive tenure  $t$ .

$$h(t, X) = h_0(t) \exp(\beta_1 x_1 + \beta_2 x_2 + \dots + \beta_{16} x_{16}) \quad (6)$$

Variable name		Symbol	Unit	Value range and description
working time		t	day	From the beginning of current tenure to the end of current tenure
right truncation		u		0: No current tenure end date, 1: has a current tenure end date
e o n o l a t i o n a l v a r i a t i o n a l a t t r i b u t e s	gender	X <sub>1</sub>		0: female, 1: male
	Education background	X <sub>2</sub>		1: technical secondary school and below, 2: junior college, 3: bachelor's degree, 4: master's degree, 5: doctor degree, 6: other
	Age at the beginning of tenure	X <sub>3</sub>	year old	
	job category	X <sub>4</sub>		1: Board positions, 2: Board of Supervisors, 3: Senior Management, 4: Party positions, 5: Others
	indication of part-time employment in other organizations	X <sub>5</sub>		0: no, 1: yes
	Number of positions	X <sub>6</sub>		up to 4
	number of titles	X <sub>7</sub>		from 0 to 6
	whether or not receiving remuneration	X <sub>8</sub>		0: no, 1: yes
	Total remuneration during the reporting period	X <sub>9</sub>	CNY	
	Number of shares held at the beginning of the period	X <sub>10</sub>	share	
	Shareholding methods	X <sub>11</sub>		0: direct shareholding, 1: indirect shareholding, 2: direct shareholding and indirect shareholding
	type of market	X <sub>12</sub>		1: Shanghai A-share market (excluding the Science and Technology Innovation Board), 2: Shanghai Stock Exchange B-share market, 3: Shenzhen Stock Exchange A-share market (excluding the Science and Technology Innovation Board), 4: Shenzhen Stock Exchange B-share market, 5: Science and Technology Innovation Board, 6: Beijing A-share market
	Business nature	X <sub>13</sub>		0: State-owned or state-controlled, 1: Sino-foreign joint venture, 2: Wholly foreign-owned, 3: Collective enterprise, 4: Private enterprise, 5: Institutions and government agencies, 6: Others
	exchange	X <sub>14</sub>		1: Shanghai, 2: Beijing, 3: Shenzhen
n a t u r e o f t h e c o m p a n y	company established	X <sub>15</sub>	year	
	stock issue premium	X <sub>16</sub>	CNY	

Figure 1. Variable description

### 3. Empirical analysis

#### 3.1. Descriptive statistics

From descriptive statistics (not listed due to space constraints) it can be seen that the average tenure of executives in the data is 1311.47 days, with the longest serving executive having been in a position for 9,130 days, with a large variance in terms of variance; approximately 81% of executives have not completed their tenure as at 31 December 2021. The statistics show that 78% of the executives are male and 22% are female; nearly half of the executives' educational background is bachelor's and master's degree; the youngest executive started their career at the age of 18 and the oldest at 92, with an average age of 46.56; more than half of the executives have held part-time positions in other companies; about 40% of the executives hold only one position, and the same 40% have one or about half of the executives do not receive remuneration from the companies they work for; nearly 80% of the executives' shareholdings are direct, with a small number participating in indirect shareholdings; 38.2%, 21.5% and 21.8% of the companies on the SSE A-share market (excluding the Keitong Board), the SZSE A-share market (excluding the GEM) and the GEM respectively; the exchanges to which the companies belong, Shanghai and Shenzhen, are more more, accounting for 46.1% and 52.5% respectively. Guangdong, Zhejiang, Beijing and Shanghai have the most enterprises. The data is basically representative of the basic situation of senior executives.

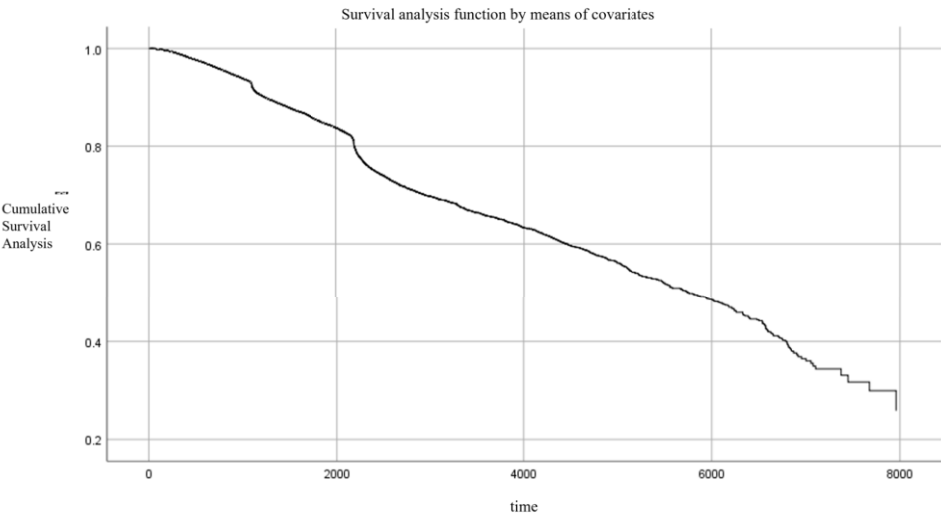
#### 3.2. Research hypothesis

$H_0$ : The risk ratio of the covariates remained constant throughout the observation period.

#### 3.3. Cox proportional risk regression results

Since the SPSS software can only give the coefficients of the survival function, the corresponding coefficients  $\beta_i$  should be judged positively or negatively in contrast to the

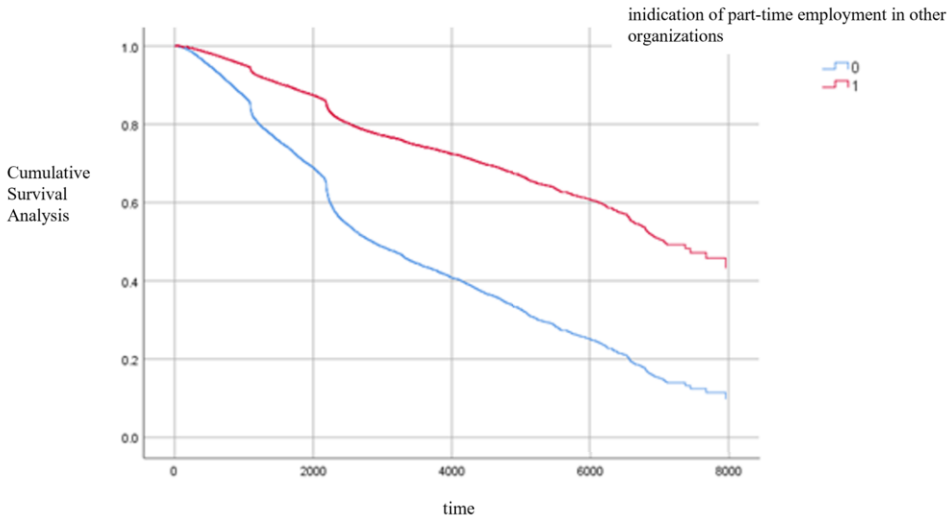
risk function as described above. In combination with the stepwise regression method for multiple experiments, variables with p-value greater than 0.1 will be considered as having no influence relationship and expelled from the model. The final significance level of the Omnibus test for the model coefficients is much less than 0.001, indicating that the model is usable. Due to the large number of variables, limited by space, the result table is no longer displayed, and only the variables with significant effects are studied later.



**Figure 2.** Survival analysis function by means of covariates

Among the personal attributes of executives, six factors passed the significance test, namely age at the beginning of tenure, number of titles, number of positions, indication of part-time employment in other organizations, whether or not receiving remuneration, and job category, indicating that these factors have an effect on the tenure of executives; among the nature of the company, four factors passed the test, namely share price at the end of the period, affiliated exchange, type of market and share issue premium, indicating an effect on the tenure of executives. Among the nature of the company, four factors, namely share price at the end of the period, exchange, market type and share issue premium, passed the test, indicating that they had an impact on the tenure of executives. Overall, personal attributes of executives have a greater impact on the length of tenure of executives than differences in the companies they work for. The cumulative survival curves plotted at the mean of the covariates are shown in Figure 2. The duration of executive tenure is generally evenly distributed by time, with no large jumps at any point in time. The model uses a large sample size and the curve is close to a smoothed state. For some of the category variables, categorical survival curves will be plotted simultaneously for explanatory purposes.

Specifically, in terms of personal attributes, the older the executive is at the start of his or her career, the greater the tendency for the duration of his or her tenure to be longer, i.e. the younger the executive the shorter the tenure is likely to be, and it can be argued



**Figure 3.** Survival function of indication of part-time employment in other organizations

that executives need to have a certain level of seniority to be able to serve. The more professional titles an executive holds, the shorter the duration of tenure. It is assumed that professional titles have a strong influence on the career progression of executives, particularly in terms of promotion and job hopping. The more positions an executive holds in his or her career, the longer he or she will stay in a particular position, which to a certain extent reflects the executive's ability to perform a variety of roles in the company and the number of promotion paths available to him or her. As shown in Figure 3, executives who hold positions in other companies are likely to have a longer tenure, presumably because of the alliance effect between the two companies where they work, and a common executive is more conducive to the union and solidity of the company. Combined with Figure 4 shows that executives who are paid prefer longer tenure, suggesting that pay will have some incentive effect if it keeps executives in the business for a long time, but there is no evidence that the amount of pay is related to length of tenure. Combined with the fact that executives in party positions have longer tenure on average and the most stable tenure, as shown in Figure 5, executives in board positions would prefer shorter tenures.

In terms of the nature of the company, the duration of executive tenure becomes shorter for companies with a higher period end share price, but this has a smaller impact. Companies belonging to the SSE and BSE have longer tenure than companies belonging to the SZSE. In terms of market type, firms affiliated with the SSE B-share market, SZSE B-share market and GEM all have a shorter duration of executive tenure than firms affiliated with the SSE A-share market (excluding GEM), while firms affiliated with the SZSE A-share market (excluding GEM) have an insignificant effect. There is a weak positive effect of share issue premium on executive tenure, with the higher the share issue premium, the more senior executives tend to stay longer.

The results of the model may not be exactly the same as commonly perceived and are explained here using gender and educational background as examples. The descriptive

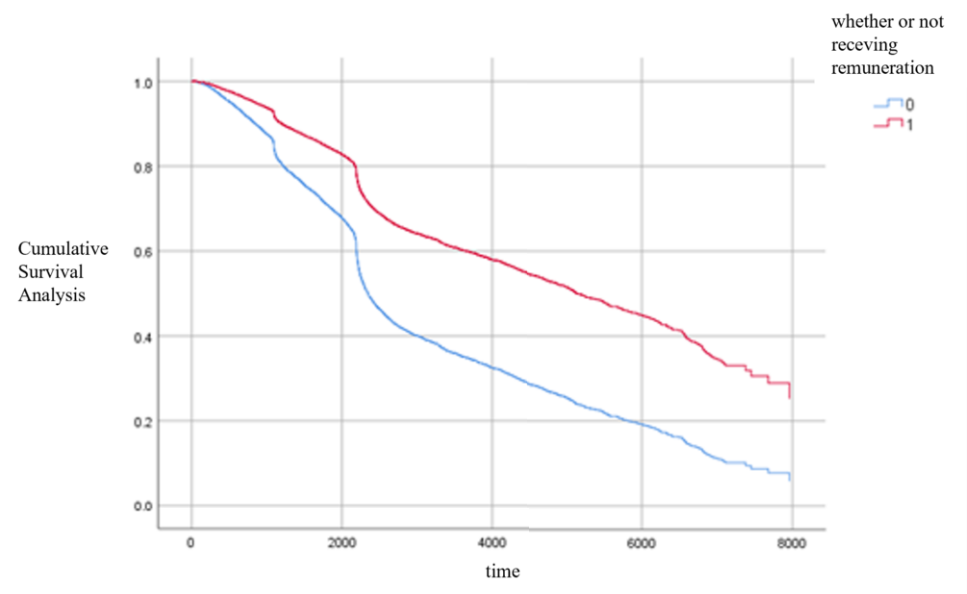


Figure 4. Survival function of whether or not receiving remuneration

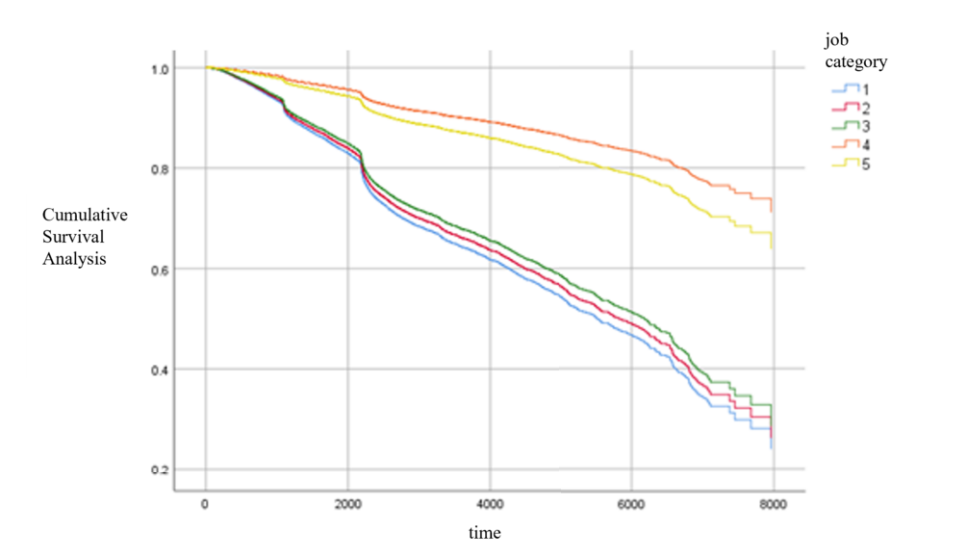
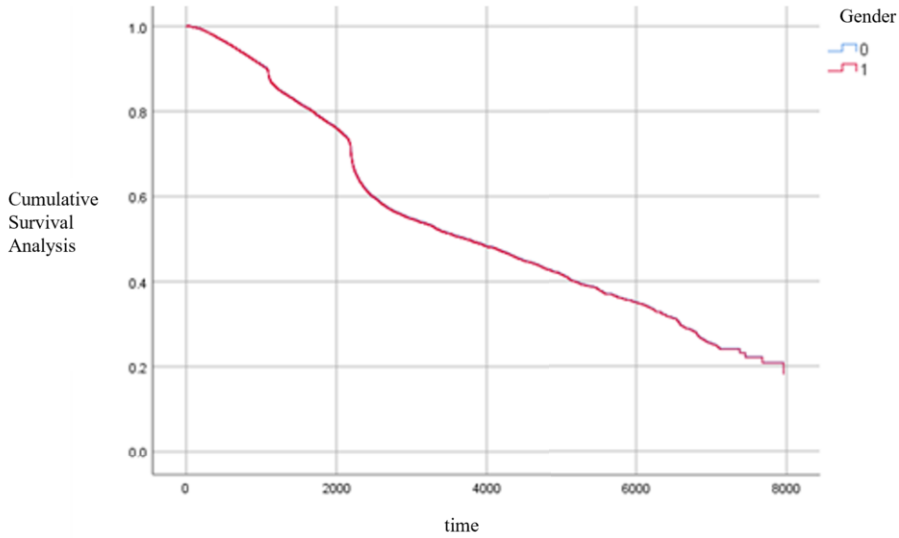


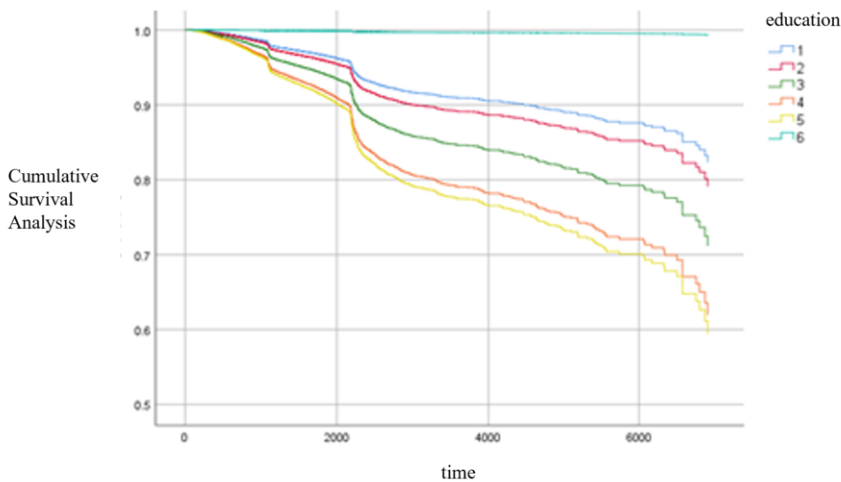
Figure 5. Survival function of job category

statistics show that the number of male executives is much larger than the number of female executives, but the survival curve in Figure 6 shows that there is no significant difference in the length of tenure between the two. In terms of educational background, Figure 7 shows that although there is a difference in the survival curves for different educational backgrounds and a tendency for executives with higher education to have longer tenure, this difference is not significant and 'other' is not constructed with missing

values, resulting in a higher probability of survival, which may have an impact on the results. This may have an impact on the results.



**Figure 6.** Survival function of different gender



**Figure 7.** Survival function of different education background

#### 4. Conclusions and recommendations

This paper constructs and empirically analyses a Cox proportional risk regression model exploring the factors influencing executive tenure based on a survival analysis approach.

The results show good application and the ability to select variables that have an impact on executive tenure practices. Different companies have the right incentives for executives to stay with the company for longer periods of time, depending on their characteristics, and similarly, executives themselves can seek the right length of tenure through their own background. Both the company and the individual executive can propose targeted measures based on the findings of the study, which are as targeted and effective as possible.

As the data sources in this paper do not fully cover the variables influencing executive tenure, and there may be some interaction effects between the variables, the research in this paper is more of a simple statistical data treatment than a more managerial one. In future research, there is a need to collect relevant data through other channels to make the study more relevant to management theory and research requirements.

## References

- [1] Buchwald A, Hottenrott H. Women on the board and executive tenure. *Managerial and Decision Economics*. (2019): 741-760.
- [2] WU L, Zhang J. A study of the differential impact of individual executive characteristics on entrepreneurial patchwork - the moderating role of market volatility. *Technology and Innovation Management*. 2022 Jan;43(01):105-114.
- [3] LI D, DUAN F. The impact of executive identity on organizational practices in a leadership behavior perspective. *Human Resources*. 2021 May;38-39.
- [4] LIN M, Ma J. Demographic background characteristics of the executive team and innovation intensity of firms - a study based on listed companies in Guangdong Province. *National Circulation Economy*. 2021;90-92.
- [5] YANG F, LUO S, REN W. A study on the relationship between executive background and corporate surplus management. *Business Accounting*. 2022;81-86.
- [6] Atayah, Osama F. et al. The ascension of executives' tenure, corporate risk-taking and corporate performance: evidence from Malaysia. *Asia-Pacific Journal of Business Administration* 2021;pp.101-123.
- [7] Cao, Xian, et al. A Meta-Analysis of the Relationship Between Chief Executive Officer Tenure and Firm Financial Performance: The Moderating Effects of Chief Executive Officer Pay and Board Monitoring. *Group & Organization Management*, vol. 46, no. 3, 2021, pp. 530–63.
- [8] Brown, Jill A., et al. Do Investors Care About Director Tenure? Insights from Executive Cognition and Social Capital Theories. *Organization Science (Providence, R.I.)*, vol. 28, no. 3, 2017, pp. 471–94.
- [9] Gill, Rafael E.. Understanding Cox's regression model. *Experientia. Supplementum* 1982(41):187-99.
- [10] BAI H, LIU X, CAO L. Analysis of the influence of congestion factors on urban expressways in mountainous areas based on Cox proportional risk model. *Smart Cities*. 2021 Apr;8(04):11-13.